

CLAIMS

What is claimed is:

[c1] 1. A method for a multi-protocol edge switch to process received data frames, the edge switch connected to at least two networks that each use distinct data link layer network protocols, the method comprising:

receiving multiple data frames transmitted from source nodes on a first of the networks that uses a first data link layer network protocol, each data frame comprising a header and a payload specified in a manner specific to the first data link layer network protocol, each header including an indication of a destination network address corresponding to a node on a second of the networks and each payload including a message specified using an application layer network protocol; and

for each of the multiple received data frames,

deconstructing the data frame to identify the indicated destination network address and the payload for the data frame, the deconstructing performed in a manner based on the first data link layer network protocol;

without deconstructing the data frame a second time, processing the deconstructed data frame by performing each of multiple processing techniques in parallel, the multiple processing techniques including,

analyzing the identified payload in order to determine a type of the included message, the analyzing performed in a manner based on the application layer network protocol used to specify the included message;

analyzing the identified payload to verify an absence of disallowed content;

selecting one of multiple nodes of the second network to which the identified destination network address corresponds, the multiple nodes

each associated with the identified destination network address, the selecting performed so as to balance processing loads on the multiple nodes; and

constructing a distinct data frame for transmission to the selected one node, the distinct data frame comprising a header and the identified payload and specified in a manner specific to the data link layer network protocol used by the second network; and

transmitting the constructed distinct data frame to the selected one node on the second network,

so that each of the received data frames can be processed in multiple ways in parallel based on a single deconstruction of the data frame before transmitting the payload of the data frame to a destination node.

[c2] 2. The method of claim 1 wherein the multiple processing techniques are each performed using distinct processing capabilities of the multi-protocol edge switch.

[c3] 3. The method of claim 2 wherein the distinct processing capabilities are distinct processors of the multi-protocol edge switch.

[c4] 4. The method of claim 1 including, before the transmitting of the constructed data frame, modifying the constructed data frame based on information generated during the analyzing of the identified payload to determine the type of the included message, the analyzing of the identified payload to verify the absence of disallowed content, and the selecting of the one node.

[c5] 5. The method of claim 1 wherein the transmitting of each of the constructed data frames is performed in a manner based on one or more of the analyzing of the identified payload to determine the type of the included message, the analyzing of the identified payload to verify the absence of disallowed content, and the selecting of the one node.

[c6] 6. The method of claim 1 wherein the data link layer network protocol used by one of the networks is an Ethernet protocol.

[c7] 7. The method of claim 1 wherein the data link layer network protocol used by one of the networks is a Fibre Channel protocol.

[c8] 8. The method of claim 1 wherein the data link layer network protocol used by one of the networks is an InfiniBand protocol.

[c9] 9. The method of claim 1 wherein the deconstructing of each of the data frames is performed by a network processor of the multi-protocol edge switch.

[c10] 10. The method of claim 1 wherein the deconstructing of each of the data frames further identifies a type of the identified payload, and wherein one or more of the processing techniques are performed in a manner based at least in part on the identified type of the identified payload.

[c11] 11. The method of claim 1 wherein the message included in at least some of the identified payloads is an HTTP message, and wherein the analyzing of each of those payloads to determine the type of the included message includes identifying a Uniform Resource Identifier specified in the message.

[c12] 12. The method of claim 1 wherein the analyzing of the identified payload of each of the received data frames includes extracting contents of the message included in that payload in a manner based on the application layer network protocol used to specify the message.

[c13] 13. The method of claim 1 wherein the transmitting of a constructed distinct data frame for a received data frame is not performed if the analyzing of

the identified payload of the received data frame to verify an absence of disallowed content fails to verify the absence.

[c14] 14. The method of claim 1 wherein the transmitting of a constructed distinct data frame for a received data frame is not performed if the selecting of the one of the multiple nodes is unable to sufficiently balance the processing loads on the multiple nodes.

[c15] 15. The method of claim 1 including, for each of the received data frames, adding to the header of the constructed data frame an indication of a second destination network address corresponding to the selected one node, the second destination network address distinct from the destination network address identified for that received data frame.

[c16] 16. The method of claim 1 including, for each of the received data frames, determining a transmittal virtual path identifier that is assigned to a path to the selected one node through the second network to which that node belongs, and wherein the transmitting of the constructed distinct data frame to the selected one node on the second network uses the determined transmittal virtual path identifier so that the data frame is routed through the second network along the path.

[c17] 17. The method of claim 16 wherein, for each of the received data frames, the determined transmittal virtual path identifier is added to the header of the distinct data frame in place of a destination network address for the selected one node.

[c18] 18. The method of claim 16 wherein the determining of the transmittal virtual path identifier that is assigned to the path to the selected one node for a received data frame includes registering with a network manager for the second

network to which the selected one node belongs and receiving in response the transmittal virtual path identifier.

[c19] 19. A computer-implemented method for processing received data communications, the method comprising:

receiving data to be communicated through a network to a destination, the received data formatted in accordance with a first protocol; and

processing at least portions of the received data that are identified as relevant by performing each of multiple techniques in parallel, the multiple techniques including,

analyzing contents included in at least some of the identified portions in order to determine whether a specified type of content is present; and

determining the destination for the received data in a manner so as to load balance multiple possible destinations.

[c20] 20. The method of claim 19 including communicating the received data to the determined destination.

[c21] 21. The method of claim 19 including determining a virtual identifier that corresponds to a path through the network to the determined destination and that will be used to route the received data through the network to the determined destination.

[c22] 22. The method of claim 19 wherein the portions of the received data to be processed are identified by deconstructing the received data.

[c23] 23. The method of claim 22 wherein the deconstructing of the received data is performed in a manner based on the first protocol.

[c24] 24. The method of claim 22 wherein the deconstructing of the received data is performed only a single time.

[c25] 25. The method of claim 19 wherein the first protocol is a data link layer network protocol.

[c26] 26. The method of claim 19 wherein the first protocol is a network layer network protocol.

[c27] 27. The method of claim 19 wherein the first protocol is a transport layer network protocol.

[c28] 28. The method of claim 19 wherein the first protocol is an application layer network protocol.

[c29] 29. The method of claim 19 wherein the first protocol is a bus protocol.

[c30] 30. The method of claim 19 wherein the first protocol is Fibre Channel.

[c31] 31. The method of claim 19 wherein the first protocol is InfiniBand.

[c32] 32. The method of claim 19 wherein the received data is a data frame or a data packet, and wherein the identified portions of the received data include a header portion of the received data.

[c33] 33. The method of claim 19 wherein the received data is a data frame or a data packet, and wherein the identified portions of the received data include a payload portion of the received data.

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[c34] 34. The method of claim 19 wherein the identified portions of the received data include entries in a header portion of the received data.

[c35] 35. The method of claim 19 wherein the identified portions of the received data include portions of a payload of the received data.

[c36] 36. The method of claim 19 wherein the analyzing of the contents included in the identified portions includes determining whether at least some of the identified portions include prohibited content.

[c37] 37. The method of claim 36 including blocking transmittal of the received data when it is determined that one or more of the identified portions include prohibited content.

[c38] 38. The method of claim 36 including, when it is determined that one or more of the identified portions include prohibited content, removing the prohibited content from the received data.

[c39] 39. The method of claim 19 wherein the analyzing of the contents included in the identified portions includes determining whether at least some of the identified portions do not include required content.

[c40] 40. The method of claim 19 including providing firewall functionality based on the analyzing of the contents included in the identified portions.

[c41] 41. The method of claim 19 wherein the multiple techniques performed in parallel further include formatting the received data in accordance with a distinct second protocol.

[c42] 42. The method of claim 19 wherein the multiple techniques performed in parallel further include analyzing at least some of the identified portions in order to classify a type of those portions of the received data.

[c43] 43. The method of claim 42 wherein the classifying of the type of the identified portions of the received data includes classifying those identified portions in a manner based on an application layer protocol used to format the data of those identified portions.

[c44] 44. The method of claim 19 wherein the method is performed by a multi-protocol edge switch connected to at least two networks that each use distinct protocols.

[c45] 45. The method of claim 19 wherein the multiple processing techniques are each performed using distinct processing capabilities of a computing system performing the method.

[c46] 46. The method of claim 45 wherein the distinct processing capabilities are distinct processors of the computing system.

[c47] 47. A computer-readable medium whose contents cause a computing device to process received data communications by performing a method comprising:

receiving data to be communicated through a network to a destination; and

processing at least portions of the received data that are identified as being of interest by performing each of multiple techniques in parallel, the multiple techniques including,

determining whether a disallowed type of content is present in at least some of the identified portions of the received data; and

load balancing multiple possible destinations in order to determine the destination to which the received data will be transmitted.

[c48] 48. The computer-readable medium of claim 47 wherein the multiple techniques performed in parallel further include classifying a type of at least some of the identified portions of the received data.

[c49] 49. The computer-readable medium of claim 47 wherein the multiple techniques performed in parallel further include formatting the received data in accordance with a second protocol distinct from a first protocol in accordance with which the received data is formatted.

[c50] 50. The computer-readable medium of claim 47 wherein the method further comprises indicating to communicate the received data to the determined destination.

[c51] 51. The computer-readable medium of claim 47 wherein the portions of the received data to be processed are identified by deconstructing the received data a single time, each of the multiple techniques using the deconstructed received data.

[c52] 52. The computer-readable medium of claim 47 wherein the computer-readable medium is a memory of a computer system.

[c53] 53. The computer-readable medium of claim 47 wherein the computer-readable medium is a data transmission medium transmitting a generated data signal containing the contents.

[c54] 54. The computer-readable medium of claim 47 wherein the contents are instructions that when executed cause the computing device to perform the method.

[c55] 55. A computing device for processing received data communications, comprising:

a first component capable of receiving data to be communicated through a network to a destination; and

multiple processing components each capable of performing one of multiple techniques in parallel in order to process at least portions of the received data, the multiple techniques including,

analyzing contents included in at least some of the identified portions in order to determine whether a specified type of content is present; and

determining the destination for the received data in a manner so as to load balance multiple possible destinations.

[c56] 56. The computing device of claim 55 wherein the computing device is a multi-protocol node on the network, and wherein the multiple techniques include formatting the received data in accordance with a second protocol distinct from a first protocol in accordance with which the received data is formatted.

[c57] 57. The computing device of claim 55 wherein the computing device is a multi-protocol edge switch.

[c58] 58. The computing device of claim 55 wherein the first component is executing in memory of the computing device.

[c59] 59. The computing device of claim 55 wherein the processing components each execute on a distinct processor of the computing device.

[c60] 60. A computer system for processing received data communications, comprising:

means for receiving data to be communicated through a network to a destination, the received data formatted in accordance with a first protocol; and

means for processing at least portions of the received data that are identified as relevant by performing each of multiple techniques in parallel, the multiple techniques including,

analyzing contents included in at least some of the identified portions in order to determine whether a specified type of content is present; and

determining the destination for the received data in a manner so as to load balance multiple possible destinations.

[c61] 61. A computer-implemented method for processing received data communications, the method comprising:

receiving data to be communicated through a network to a destination, the received data formatted in a first manner;

deconstructing the received data in order to identify portions of the received data that each have contents; and

processing the deconstructed data by performing at least three of multiple techniques in parallel, the multiple techniques including,

classifying a type of at least some of the contents of the received data;

analyzing at least some of the contents in order to determine whether a disallowed type of content is present;

determining the destination for at least some of the contents in a manner so as to load balance multiple possible destinations; and

formatting at least some of the contents in a distinct second manner.

[c62] 62. The method of claim 61 including communicating the formatted contents to the determined destination.

[c63] 63. The method of claim 61 including determining which of the multiple techniques to perform based on the received data.

[c64] 64. The method of claim 61 including performing each of the multiple techniques.

[c65] 65. A computer-implemented method for processing received data communications, the method comprising:

receiving data to be communicated through a network to a destination, the received data formatted in accordance with a first protocol; and

processing at least portions of the received data that are identified as relevant by performing at least two of multiple techniques in parallel, the multiple techniques including,

classifying a type of at least some of the identified portions;

analyzing contents included in at least some of the identified portions in order to determine whether a specified type of content is present; and

formatting at least some of the identified portions in accordance with a distinct second protocol that is selected based on the destination.

[c66] 66. The method of claim 65 including determining which of the multiple techniques to perform based on the received data.

[c67] 67. The method of claim 65 including performing each of the multiple techniques.

[c68] 68. A computer-implemented method for processing received data communications, the method comprising:

receiving data to be communicated through a network to a destination, the received data formatted in accordance with a first protocol; and

processing at least portions of the received data that are identified as relevant by performing at least two of multiple techniques in parallel, the multiple techniques including,

classifying a type of at least some of the identified portions;

determining the destination for at least some of the identified portions in a manner so as to load balance multiple possible destinations; and

formatting at least some of the identified portions in accordance with a distinct second protocol that is selected based on the determined destination.

[c69] 69. The method of claim 68 including determining which of the multiple techniques to perform based on the received data.

[c70] 70. The method of claim 68 including performing each of the multiple techniques.

[c71] 71. A computer-implemented method for processing received data communications, the method comprising:

receiving data to be communicated through a network to a destination; and

processing at least portions of the received data that are identified as relevant by performing each of multiple techniques in parallel, the multiple techniques including,

classifying a type of contents of at least some of the identified portions of the received data;

analyzing contents of at least some of the identified portions in order to determine whether a disallowed type of content is present;

determining the destination for contents of at least some of the identified portions in a manner so as to load balance multiple possible destinations; and

formatting contents of at least some of the identified portions in accordance with a second protocol corresponding to the destination.